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10/526,975	10/25/2005	Richard Schneider	01309.0008.PCUS00	7986

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TRAN, DALENA	
ART UNIT	**PAPER NUMBER**
3664	
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No. 10/526,975	Applicant(s) SCHNEIDER ET AL.	
	Examiner Dalena Tran	Art Unit 3664	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on 11 May 2009.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 1-14 is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) 1-14 is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____is/ are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Notice to Applicant(s)

1. This office action is responsive to the amendment filed on 10/14/08. Claims 1-14 are pending.

Claim Rejections - 35 USC § 102

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

3. Claims 1-14, are rejected under 35 U.S.C. 102(e) as being anticipated by DE 10062606 (refers as '606).

As per claim 1, ('606) discloses a method for monitoring the state of a vehicle chassis, the method comprising: measuring physical variables on the chassis by means of sensors (see [0003-0005]), providing a model of the vehicle which continuously identifies parameters of the vehicle and uses such parameters to continuously compile modeled variables in a simulatory prognosis of the vehicle behavior (see [0008-0010], and [0025-0028]); comparing the measured variables with the modeled variables by means of a processing unit, wherein the modeled variables are determined from specific variable (see [0023-0024]), performing a classification into classes of causes on the basis of the comparison and evaluating is a result of the classification (see [0029-0034]).

As per claims 2-3, ('606) discloses speeds, acceleration, or forces are measured as physical variables, and determining or updating a remaining lifetime of vehicle components before a critical state is reached or before a maintenance measure is needed, using at least one damage evolution or ageing model of the vehicle components (see [0011-0014], and [0036-0038]).

As per claim 4, ('606) discloses the comparison of the measured variables and the modeled variables is made by means of a correlation (see [0036-0038]).

As per claims 5-7, ('606) discloses the classification is performed by means of the processing unit, and the classification is made as to whether a cause inside the vehicle or an external cause is involved (see [0029-0034]).

As per claim 8, ('606) discloses the modeled variables are calculated (see [0025-0028]).

As per claim 9, ('606) discloses a device for monitoring the state of a vehicle chassis, in comprising: one or more sensors for measuring physical variables on the chassis (see [0003-0005]); a processing unit for calculating modeled variables, by continuously identifying vehicle parameters and continuously compiling a simulatory prognosis of the chassis behavior using a model of the chassis (see [0008-0010], and [0025-0028]); for comparing the measured variables with the modeled variables (see [0023-0024]), and for classifying as a result of the comparison; and means for evaluating the classified results (see [0029-0034]).

As per claim 10, ('606) discloses the processing unit comprises: at least one damage evolution or ageing model of chassis components which is used to determine or update a remaining lifetime before a critical state is reached or before a maintenance measure is required (see [0029-0034).

As per claim 11, ('606) discloses an interface to a superordinate control system of the vehicle is connected to the processing unit, via which data on an actual driving state is delivered to the processing unit or messages therefrom may be saved and may be transmitted to a driver or traction unit conductor or an external control centre (see [0025-0028])

As per claim 12, ('606) discloses at least one sensor is a vibration sensor, an acceleration sensor, an impact sensor, an acoustic sensor, a sound sensor, an eddy current sensor, a magnetic field sensor, a temperature sensor, a force sensor, an strain sensor, a distance sensor, a radar Doppler sensor or an ultrasound sensor (see [0003-0005]).

As per claim 13, ('606) discloses at least one sensor is arranged on a component selected from the group consisting of: on a wheelset, a wheelset axle, wheelset bearing, on a bogie, a chassis frame, on a primary spring suspension, a spring, a shock absorber, a wheelset guide, a secondary spring suspension, a stabilizer, a stop buffer, a traction linkage, on a drive, a drive motor, a gear, a clutch, a drive suspension, a brake, a brake disk, a brake cylinder, a brake lining, a brake pad, a brake linkage, and a brake caliper (see [0035]).

As per claim 14, ('606) discloses the means for evaluation comprise a signaling device inside the vehicle or a signaling device in a mobile or stationary control centre outside the vehicle including a data transmission device from the vehicle to the control centre (see [0038]).

Remarks

4. Applicant's amendment filed on 5/11/09 has been fully considered. Upon updated search, the new ground of rejection as above.

5. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Dalena Tran whose telephone number is 571-272-6968. The

examiner can normally be reached on M-W (in a first week of a bi-week), and T-R (in a second week of bi-week) from 7:00AM-6:00PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Khoi H. Tran can be reached on 571-272-6919. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Dalena Tran/
Primary Examiner, Art Unit 3664
August 24, 2009

DE 10062606 all (102e)

①

PTO 09-0900

CC=DE DATE=20020613 KIND=A1
PN=10062606

PROCESS AND DEVICE FOR MONITORING THE MECHANICAL STATE OF ELECTRICALLY PROPELLED VEHICLES IN REGULAR TRAVEL

[Verfahren und Einrichtung zum Ueberwachen des mechanischen Zustands von electrisch angetriebenen Fahrzeugen im regulaeren Fahrbetrieb]

Matthias Kipke et al.

UNITED STATES PATENT AND TRADEMARK OFFICE
Washington, D.C   November 2008

Translated by: FLS, Inc.

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INTERNATIONAL CLASSIFICATION	(51)	G07C 5/08; G01M 17/00; B60L 3/00; B61L 23/00
PRIORITY	(30)	
INVENTOR	(72)	KIPKE, MATTIAS; AMANN, NOTKER
APPLICANT	(71)	DAIMLERCHRYSLER AG
DESIGNATED CONTRACTING STATES	(81)	
TITLE	(54)	PROCESS AND DEVICE FOR MONITORING THE MECHANICAL STATE OF ELECTRICALLY PROPELLED VEHICLES IN REGULAR TRAVEL
FOREIGN TITLE	[54A]	VERFAHREN UND EINRICHTUNG ZUM UEBERWACHEN DES MECHANISCHEN ZUSTANDS VON ELECTRISCH ANGETRIEBENEN FAHRZEUGEN IM REGULAEREN FAHRBETRIEB

Specification /1*

[0001] The invention relates to a process and device for monitoring the mechanical state of electrically propelled vehicles in regular travel.

[0002] Repeated accidents in the railway car domain have led to an enhanced consciousness of safety and have highlighted the need for suitable monitoring devices for railway car components or arrangements thereof. These monitoring devices have the additional benefit that maintenance of the cars can be done as necessary. Instead of the periodic maintenance which has been conventional for a long time, it is possible to perform maintenance only when the corresponding necessities prevail. This greatly reduces maintenance costs.

[0003] The monitoring devices should be suitable for detecting the properties and functions of car components which change with time due to mechanical stress and mechanical wear and for providing indications of incipient or existing damage if necessary.

[0004] For detection of incipient or spontaneous damage to railway cars and/or the pertinent track body for example DE 198 37 485 A1 discloses approaches in which sensors which are arranged distributed locally on railway cars are used for detecting the vibration behavior of car components or arrangements of them. Car components can be for example a wheel set, bearing, gearing, or couplings.

10a 10a 12

[0005] Primarily vibration or noise measurements are taken. DE 198 37 486 A1, DE 198 37 554 A1 and DE 198 37 486 A1 disclose use of acceleration transducers or vibration sensors in general in this respect. The use of acoustic sensors, for example a microphone on the

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*Numbers in the margin indicate pagination in the foreign text.

bogie, is known from DE 198 31 176 A1 and DE 198 30 685 A1.

[0006] Signal evaluation processes, for example known from DE 198 37 476 A1, are based essentially on the evaluation of vibrations or noise with reference to frequency and amplitude. For differentiation of the fault case and normal case it is known that pattern comparison processes are used in which current patterns which have been obtained during operation are compared to reference patterns which have been determined in the undisturbed or "new state" and lead to triggering of alarms when deviations are significant.

[0007] All known approaches to monitoring devices for use on railway cars are thus based on the use of additional sensors.

[0008] Measured electrical variables are used for example only to detect damage to the electrical system, for example motor damage such as bar fracture or insulation damage, such as described for example in "Motor with Secondary Function - Electric Drives as Virtual Sensors in the Automobile", Gospodaric, D; Iamandi, H., Carl Hanser-Verlag, Munich, F & M Jhg. 107 (1999), No. 4, pp. 14-18. It is conventional to monitor motor currents with respect to exceeding the boundary values. This typically leads to the pertinent motor being shut off.

[0009] Thus the object of the invention is to devise a process for continuous monitoring of the state which accompanies operation during regular travelling of electrically motorized railway cars and/or road vehicles, with the objective of reliable and low-cost early detection of damage to the car mechanism or to the chassis undercarriage mechanism on the whole or in their individual components in the incipient stage, i.e. largely without additional sensors. Moreover a device for executing the process will be devised.

[0010] The object mentioned first is achieved by a process for monitoring the mechanical state of an electric motor-propelled vehicle in regular travel, and as claimed in the invention by detecting at least one measured electrical quantity of the motor and model-based evaluation of the measured variable, damage to chassis or undercarriage mechanisms can be detected. The process is thus suited for detecting the state of the vehicle and diagnosis and identification of damage of the chassis or undercarriage mechanisms and of their components.

[0011] The invention uses the effect that the properties and functions of the components of the vehicle or chassis or undercarriage in regular operation change with time as a result of mechanical wear and/or mechanical overstress outside of the specification.

[0012] These changes lead to continuous expression of component-specific modulations in the torque of the electric drives propelling the vehicle. These torque modulations which are reflected in the engine currents can be separated by suitable spectral evaluation processes by way of motor currents in the form of characteristic interference frequency portions. For spectral analysis, for example FFT, wavelets, cepstrum or model-based frequency analysis methods can be used.

[0013] The use of sensors which are present anyway, such as for example current sensors, voltage sensors, or tachogenerators, for these monitoring devices ensures low-cost execution of the process. Additional sensors are no longer necessary.

[0014] Evaluating signals over a long time interval and checking for special defects with model-based and time-weighted methods additionally ensure reliable execution of the process. The process is thus suitable both for railway cars and road vehicles.

[0015] Preferably statistical methods, such as for example time series analysis or gradient development, are used for damage prediction.

[0016] In particular, the frequencies can be separated according to the type of their occurrence into continuous, sporadic, conditional or random for further processing by means of classifiers (neural network, neuro-fuzzy).

[0017] In another embodiment, damage is ascertained from noncritical changes by monitoring the component-specific threshold values being exceeded for the detected interference frequency amplitudes and the corresponding gradients of the amplitude changes over time.

[0018] The second object is achieved by a device for executing the process.

[0019] Other advantageous embodiments of the invention are given in the dependent claims.

[0020] The invention is detailed in the figures using several embodiments.

[0021] Figure 1 shows an extract from a process for monitoring the mechanical state of a vehicle or car in a schematic;

[0022] Figure 2 shows the use of the process in a railway car in a schematic.

[0023] Figure 1 illustrates a process for monitoring the /2 mechanical state of a vehicle propelled by an electric motor 2, for example a railway car or a passenger car, in regular travelling with its important operating elements, in a schematic.

[0024] The electric motor 2 is used as an intelligent sensor or

part of an intelligent sensor system. In a preprocessing stage 4 which is present once per electric drive, first the damage-relevant interference frequency portions are separated from the frequency portions which are characteristic of normal operation. For this purpose, in this embodiment the currents i and optionally the voltages u of the electric motor 2 which represents the real process here, are measured or detected and compared to the current and voltage outputs $\tilde{i}$ and $\tilde{u}$ of a process model 6 for normal operation. In embodiments which are not further shown however other measured variables of the motor, i.e. at least one measured variable, can be further processed with this process.

[0025] The process model 6 in this embodiment is a rpm-adapted model (for example, disturbance observer, fuzzy, neural network or neuro-fuzzy).

[0026] The residues which remain after passing through a comparison operation 8 are subjected to spectral analysis 10 in which the separated interference frequency portions for example of the motor current are decomposed into individual frequency portions f_1 to f_n. The individual frequencies are separated for further signal evaluation first in a classifier 14 with respect to their occurrence, for example continuous, sporadic, conditional, random, for further processing by means of further classifiers, such as a neural network or neuro-fuzzy.

[0027] The interference frequency portions which fall below a minimum amplitude are separated within a threshold value stage 16, by which the ruggedness of the process can be increased.

[0028] Advantageously the process does not require any additional vibration sensors or acoustic sensors for its use, in contrast to the

prior art, since the detection of damage or of changes which have occurred are derived from the measured current and/or voltage values and optionally rpm information which are available anyway and which are required for motor control of railway cars and road vehicles which are propelled by means of electric motors.

[0029] Figure 2 shows the use of the process on the example of a railway car with two bogies which are driven by means of electric motors. The motors are not explicitly shown here, but are represented by the two preprocessing stages 20, 22.

[0030] The differentiation of roadway damage, vehicle mechanism damage and/or ~~motor damage is done in~~ a correlation stage 24 in which correlation functions are applied to the individual separated interference frequency portions of the drives, in this embodiment, two.

[0031] Damage to the roadway, for example can be identified by the sporadic, time-limited occurrence of interference frequencies f_{ij}, these interference frequencies f_{ij} first being detected by the preprocessing stage 20 in the first bogie of the electric drive assigned to the railway car, represented by way of the corresponding motor, and then being detected by the preprocessing stage 22 with a time offset 26 which is dependent on the distance of the two electric drives between one another and the speed of the car, also in operation of the second bogie, represented by way of the corresponding motor.

[0032] Damage to the undercarriage mechanism typically leads conversely leads to formation of continuous interference frequencies with different interference frequency amplitudes which however increase with time. For differentiation of damage to the wheel set, axle or gearing moreover correlations with the rpm of the electric motor, for

example harmonic multiples of the rotational frequency, are evaluated.

[0033] Motor damage, for example bar fracture or winding damage, leads to interference frequency portions which are correlated to the frequency, for example an integral harmonic of the feed converter.

[0034] After preselection 28 of the interference frequency portions which are dictated by roadway damage, vehicle mechanism damage and/or motor damage, further differentiation takes place based on defect models 30 for which likewise a disturbance observer, fuzzy, neural networks or neuro-fuzzy are possible.

[0035] In the defect models 30, damage-typical interference frequency patterns as reference patterns are implemented for the undercarriage components which are relevant for monitoring, for example wheel set, axle, gearing, bearings. Each of these reference patterns are assigned tolerance ranges via which variances of the properties or of the damage behavior of the monitored undercarriage components will be considered. Moreover the defect models 30 contain, among others,
17 information about the probabilities of occurrence of individual damages, on typical damage behavior patterns and/or on the time progression of damage combinations.

[0036] For monitoring the deterioration of specified properties of the undercarriage components to be monitored or of the motor, for
3 purposes of trend analysis statistical evaluation processes 32 are applied both to absolute interference frequency amplitude values and
4 also to their gradients.

[0037] To safeguard damage prediction, in a decision logic unit 34 the output information after statistical evaluation is compared to the probabilities of occurrence of the predicted damage and weighted as

well as examined with respect to the presence of damage combinations or possible damage overlapping based on defect models 30.

[0038] In a downstream threshold value stage 36 the differentiated, component-referenced ascertained damage is evaluated with respect to its degree in order to trigger specific actions 38, such as messages, warnings, alarms or system shutdowns. Damage can be ascertained from noncritical changes by monitoring the component-specific threshold values being exceeded for the detected interference frequency amplitudes and the corresponding gradients of the amplitude changes over time.

Claims

1. Process for monitoring the mechanical state of a vehicle propelled with an electric motor (2) in regular travelling, characterized in that by detecting at least one measured electrical variable of the motor (2) and a model-based analysis (10) of the measured electrical variable, damage of the undercarriage mechanism is detected.

2. Process as claimed in Claim 1, characterized in that the motor /3
current i is detected as the measured electrical variable.

3. Process as claimed in Claim 1, characterized in that the motor voltage u is detected as the measured electrical variable.

4. Process as claimed in one of Claims 2 or 3, characterized in that the measured rpm value is additionally detected as a measured electrical variable.

5. Process as claimed in one of Claims 1 to 4, characterized in that disturbances or incipient faults referenced to the motor, undercarriage mechanism and/or roadway are distinguished by using correlation functions.

6. Process as claimed in one of Claims 1 to 5, characterized in that the process model (6) is a rpm-adapted model for normal operation.

7. Process as claimed in one of Claims 1 to 5, characterized in that damage-typical interference frequency patterns as reference patterns are implemented by a defect model (30).

8. Process as claimed in Claim 7, characterized in that statistical methods for trend analysis are used for damage prediction.

9. Process as claimed in one of Claims 1 to 8, characterized in that the frequencies of the measured electrical variables are separated

according to the type of their occurrence into continuous, sporadic, conditional or random for further processing.

10. Process as claimed in one of Claims 1 to 9, characterized in that damage is ascertained from noncritical changes by monitoring the component-specific threshold values being exceeded for the detected interference frequency amplitudes and the corresponding gradients of the amplitude changes over time.

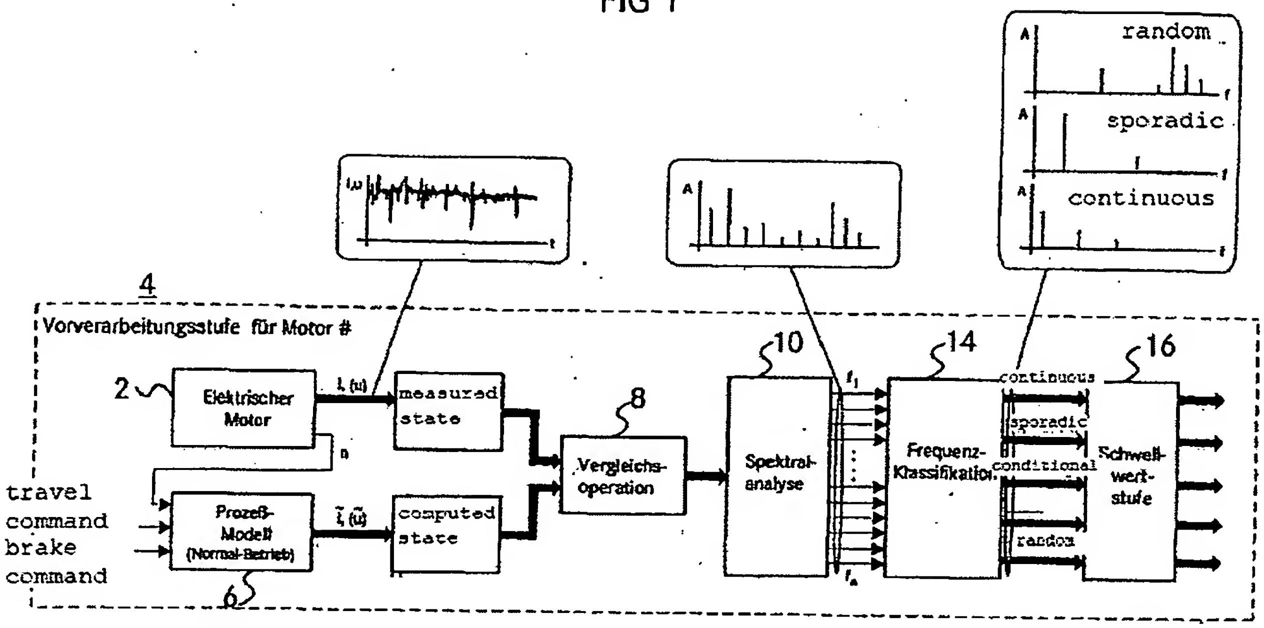
11. Process as claimed in one of Claims 1 to 10, characterized in that the electric motor (2) is used as an intelligent sensor or part of an intelligent sensor system in railway cars and road vehicles.

12. Device for executing the process as claimed in one of Claims 1 to 11.

Two pages of drawings attached

Figure 1

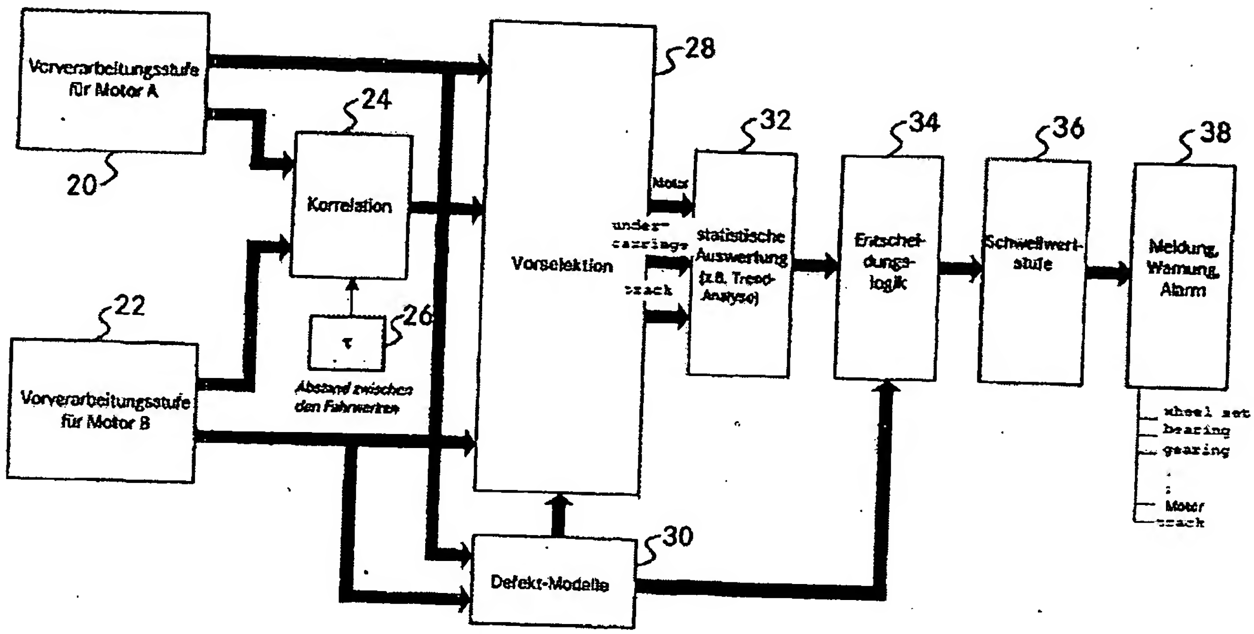
FIG 1



Key: (2) electric motor; (4) preprocessing stage for motor; (6) process model (normal operation); (8) comparison operation; (10) spectral analysis; (14) frequency classification; (16) threshold value stage

Figure 2

FIG 2



Key: (20) preprocessing stage for motor A; (22) preprocessing stage for motor B; (24) correlation; (26) distance between undercarriages; (28) preselection; (30) defect model; (32) statistical evaluation (for example, trend analysis); (34) decision logic unit; (36) threshold value stage; (38) message, warning, alarm